

Preface: Artificial Evolution

What is it, how it relates to synthetic biology and our project

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By artificial evolution people normally mean something either very simple, as when peasants select the cabbage seeds for next year's crossbreed, a practice long existed before Darwin's age[1]; or something somehow nebulous, involving complex design of circuits, algorithms, and a lot of computing[2]. The former has secured its place in the genetics textbooks and we shall leave it there; the latter still gives us plenty of spaces for fathoming so that's where we'll start.

Back in 2012, Masami Hagiya and Ibuki Kawamata did a simplification of Channon's approaches to synthetic biology as described in figure 1 below. They generalized the ultimate goal of synthetic biology as "encapsulated complex systems"[3], which is the (theoretical) direction our project is looking at from a faraway distance (in practice).

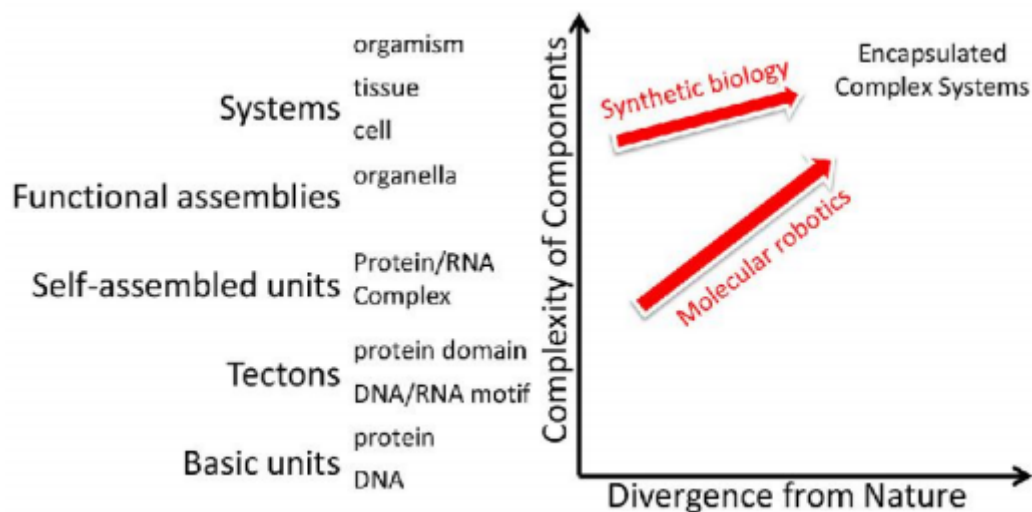


Figure 1: Where is Synthetic Biology Going?—the ultimate destination. Source: Towards Co-evolution of Information, Life and Artificial Life. Masami Hagiya and Ibuki Kawamata. Natural Computing and Beyond. Page41.

Synthetic biology may or may not have walked half the distance illustrated above, but perhaps it doesn't hurt thinking a little bit ahead, even if that's where we are yet to reach. One would argue that synthetic biology doesn't need to go so far as to reach the "ultimate goal" referred to by Hagiya et al, for mass utilities and applications are already emerging with every tiny step forward. It's true; however, thinking afar also has its advantages, for afar is where more possibilities dwell.

Synthetic biologists are not thinking about accelerating evolution on purpose when they work, implying so would be a potential insult for some synthetic biologists who regard their work as a pure joy unto itself. However, when we ponder about various implications of their

work in **hindsight**, we might reluctantly piece the word “artificial evolution” and “synthetic biology” together. Cutting out a gene and paste it into another being, it’s a creative process that shares more common spirit with the dynamic artists, designers and handcrafters than with the thrilled aspirants, utopians and zealots.

In another word, synthetic biologists are not ambitious *on purpose*; however, not on purpose is not enough. Synthetic biology is still exploring its exact definitions, defining it according to our best wishes might not be a completely honest way to face the problems that will arise sooner or later because of its unaddressed implications. We don’t think synthetic biology should have the word “artificial evolution” anywhere in its definition, but we do think that it is an implication of what synthetic biology is capable of doing.

Evolution as a theory is controversial, but evolution as a word is not. The difference is well told by Stephen C. Meyer, Michael Newton Keas in The Meanings of Evolution [4], where they describe and unpack the six most common definitions of “evolution” in most biology textbooks. Various definitions make its meaning nebulous, but one brief description should be non-disputable: change through adaptation or mutation[5]. Other debates, such as change of what kind, by what means, wherefrom... are not ours to take on. So the phrase “artificial evolution” that we use here uses evolution as a word simply equivalent to: change, whether through adaptation or genetic mutation.

Artificiality “is the state of being the product of intentional human manufacture, rather than occurring naturally, through processes not involving or requiring human activity [6].” Combining artificial with evolution, we get our own definition of artificial evolution: Causing change, whether through adaptation or genetic mutation, by intentional human manufacture, in organisms.

That sounds familiar, isn’t it?

The SyntheticBiology.org describes synthetic biology as “the design and construction of new biological parts, devices, and systems, and the re-design of existing, natural biological systems for useful purposes”[7]; the iGEM foundation says “a synthetic biologist looks to co-opt and improve upon the genetic blueprints of existing organisms, to design and create novel biological devices and systems.” [8]

So, synthetic biology might as well be doing the job of artificial evolution, it’s just a different saying with a suffix of “for useful purposes”, and with “using standardization” printed in bold. The major difference lies in the purpose: where artificial evolution is to cause change, synthetic biology “looks to co-opt and improve”, to “design and create”.

	Artificial Evolution	Synthetic Biology
Causing change in organism	✓	✓
Human manufacture	✓	✓
Ultimate Concern	Direction, ending	Utility, itself
Purposes	?	Co-opt, improve, design, create
Interrelationship	Synthetic biology in hindsight	Has the “side-effect” of artificial evolution;

Figure 2: Conceptual similarities and differences of Artificial Evolution and SynBio: A comparison

Or it could be said:

- synthetic biologists are not accelerating evolution on purpose;
- but synthetic biology might be.
- artificial evolution is synthetic biology in hindsight.

However, if we link synthetic biology with artificial evolution like this, some more questions arise. The question of the “wherefrom” of evolution is well disputed between evolutionists and creationists and is not of our current concern, but the question of “whereto” of artificial evolution has seldom been addressed.

Though it seems that we are all content with the bricks we have and can make; after all, a successfully engineered BioBrick is already art, feat, and use enough. Comparing with the present that we are gifted with and that its own possibilities has not been exhausted yet, the future is too far for us to seriously talk about it without sounding self-assuming and ridiculous. However, since we agree with what William Gibson said in *The Economist*: “The future has already arrived, it’s just not evenly distributed yet![9]” We guess that, if we cannot be comprehensive, then at least try to be original.

we have three subparts:

- Ethics: One Psychological Origin of the Synthetic Biology Ethics
- Aesthetics: To Mimic the Intricacies of Nature—Our Design Principles
- Semiotics: Metaphysics of iGEM in the Context of Runic Alphabets

Reference: please see our website